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TITLE: LASER WELDING METHOD FOR DIFFERENT KIND OF METAL

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ABSTRACT:

PURPOSE: To prevent deformation of welded member and maintain joining strength in laser welding of a high melting point member to be welded and a base metal to be welded of different kind by irradiating a laser beam from the base metal side and forming a nugget of the base metal around the high melting point member.

CONSTITUTION: In the cathode of an electronic tube, a coil heater consisting of high melting point thin wire such as W, Mo etc. and a heater support 3 consisting of an Ni plate are positioned. Then, a coiled connecting part 2a is pressed against the heater support 3 by a pressing plate 10 and brought into close contact. Welding is performed by irradiating a converged beam 11a of a laser device 11 from the heater support 3 side. By this way, the heater support 3 is molten and flows to the coiled connecting part 2a side. A nugget 3b of the heater support 3 encloses and diffuses the coiled connecting part 2a without causing deformation and maintains joining strength.

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⑭異種金属のレーザ溶接法

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明 細 書

発明の名称 異種金属のレーザ溶接法

特許請求の範囲

タングステン、モリブデンなどの高融点細線または高融点薄板よりなる高融点被溶接部材を鉄板、ニツケル板などよりなる被溶接母材にレーザ溶接する異種金属のレーザ溶接法において、前記被溶接母材側よりレーザ照射して被溶接母材の溶融流れを生じさせ、前記高融点被溶接部材の細線の周囲または薄板に設けた小孔の周囲に前記被溶接母材のナゲツトを形成させて接合することを特徴とする異種金属のレーザ溶接法。

発明の詳細な説明

本発明は異種金属のレーザ溶接法、更に詳しくはタングステン、モリブデンなどの高融点細線または高融点薄板と鉄板、ニツケル板などとの異種金属のレーザ溶接法に係り、特に電子管陰極構体を構成するコイルヒータとヒータサポートの溶接に好適なレーザ溶接法に関する。

陰極構体は、第1図に示すようにカソード1の内部に挿入されているコイルヒータ2のコイル状接続部2a、2aを一対のヒータサポート3、3の突起部3a、3aにそれぞれ溶接組立してなる。

従来、コイル状接続部2aとヒータサポート3の溶接は、ヒータ2およびヒータサポート3、3を保持治具（図示せず）で位置決め固定した後、コイル状接続部2aとヒータサポート3とを一対の溶接電極4、5で数㎏の加圧力を加えた状態で挟持し、電源装置6で発生した電力をフイーダ線7により溶接電極4、5に導き、抵抗発熱させてコイル状接続部2aと突起部3aを接合する、いわゆるスポツト抵抗溶接法が一般に行なわれている。

しかしながら、陰極構体においては、コイルヒータ2は材質がタングステンなどの高融点金属で、かつ素線径が20〜50μmの極細線をコイル外径0.1〜0.2mm、巻ピツチ約0.1mmに巻線された微小なヒータよりなり、またヒータサポート3は板厚約0.2mmの鉄板またはニツケル板などよりなるので、次に述べるような障害がある。

すなわち、溶接電極４、５の材質はクローム銅合金などの軟質導電金属であるので、溶接時に被溶接材の発熱により加熱される。このため、溶接電極４、５の接触面は酸化膜の付着や摩耗が発生し、初期の溶接条件が維持されなくなるので、溶接電極４、５が裕度内を越えない１００～２００点溶接毎に初期状態に再研磨または部品交換が必要となる。また溶接時に被溶接材の接触抵抗を極力小さくするために３kg以上の加圧力を加える必要があるので、ヒータコイル２が変形するという不具合があつた。

このような問題点はレーザ溶接法を採用することにより解消される。ところで、前記したコイル状細線を鉄板などの被溶接母材にレーザ溶接する場合、一般的に細線側よりレーザ照射して２種金属を融合させている。しかしながら、かかる方法は前記した加圧力によるヒータコイル２の変形は生じないが、高融点細線と鉄板を融合させて溶接することにより、細線の変形が生じる。またスパータリングや穴あけなどの異常加工を行なうため、接合強度が劣化する欠点がある。

本発明の目的は、被溶接部材の変形を防止すると共に、接合強度を維持することができる異種金属のレーザ溶接法を提供することにある。

以下、本発明の一実施例を第２図により説明する。なお、陰極構体は第１図と同じ構成よりなるので、符号１～３は同一符号を付し、その説明を省略する。まず、ヒータ２およびヒータサポート３を保持治具（図示せず）で位置決めした後、押え板１０によりコイル状接続部２ａをヒータサポート３に押付け、コイル状接続部２ａをヒータサポート３に確実に密着させる。そして、ヒータサポート３側よりレーザ装置１１の集束ビーム１１ａをヒータサポート３に照射して溶接する。なお、押え板１０には溶接点近傍に逃げ穴１０ａを設け、溶着を防止している。

このようにヒータサポート３側よりビーム照射するので、第３図に示すように矢視Ａ方向のビーム照射によつてヒータサポート３が溶融してコイル状接続部２ａ側に流れ、ヒータサポート３のナゲツト３ｂがコイル状接続部２ａを変形させることなく包容し、また拡散接合されて接合強度が維持される。引張り試験の結果、接合部外で断線し、接合強度は十分保持されていることが判つた。

第４図は本発明の他の実施例を示す。本実施例はヒータサポート１３の接続部をスリーブ状に成形したもので、このように成形されたヒータサポート１３を用いると、第５図に示すようにレーザ照射によるヒータサポート１３のナゲツト１３ａがコイル状接続部２ａの全周を包囲するように形成されるので、接合部の機械強度が一層向上する。また本実施例はヒータサポート１３がコイル状接続部２ａを挟持する形ちとなるので、集束ビーム１０ａ照射側１３ｂの反対側１３ｃが押え板１０の働きもする。

なお、上記実施例は電子管陰極構体のコイルヒータの接続について説明したが、本発明の方法は電子管陰極構体のコイルヒータに限らず広く適用できる。また接続部２ａはコイル状に限らず直線状の細線にも同様に適用できる。また高融点薄板と被溶接母材との接合にも、高融点薄板に小孔を加工して被溶接母材の溶融流れが前記小孔を埋設する現象を利用して接合することができる。

以上の説明から明らかな如く、本発明によれば、被溶接部材を変形させることがなく、また接合強度を保持して接合される。

図面の簡単な説明

第１図は従来の抵抗溶接法の斜視図、第２図は本発明のレーザ溶接法の一実施例を示す正面図、第３図は第２図の接合部の拡大断面図、第４図は本発明のレーザ溶接法の他の実施例を示す斜視図、第５図は第４図の接合部の拡大断面図である。

２ａ…コイル状接続部、　３…ヒータサポート、
３ｂ…ナゲツト、　１１…レーザ装置、
１１ａ…集束ビーム、　１３…ヒータサポート、
１３ａ…ナゲツト。

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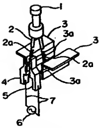
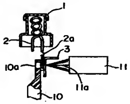
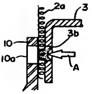
第 1 図



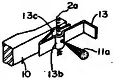
第 2 図



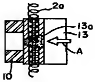
第 3 図



第 4 図



第 5 図



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(54) LASER WELDING METHOD FOR DIFFERENT METALS	
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SPECIFICATION

Title of the Invention

Laser Welding Method for Different Metals

Scope of Patent Claims

A laser welding method for different metals wherein a high-melting member to be welded composed of a high-melting thin plate or a high-melting wire such as tungsten or molybdenum is laser-welded to a base member to be welded composed of an iron plate, nickel plate or the like, said laser welding method for different metals characterized in that laser irradiation is performed from the side of said base member to be welded, thereby generating a melted flow of base member to be welded, and joining occurs when a nugget of said base member to be welded is formed at the periphery of a small hole formed in the thin plate or at the periphery of the wire of said high-melting member to be welded.

Detailed Description of the Invention

The present invention relates to a laser welding method, and specifically relates to a laser welding method for different metals that is used for welding high-melting wire or high-melting thin sheet such as tungsten or molybdenum with materials such as iron plate or nickel plate. In particular, the present invention relates to a laser welding method that is suitable for welding heater supports and heater coils that constitute electron tube negative electrode structures.

Negative electrode structures are produced by welding and assembling the coil connectors **2a**, **2a** of a heater coil **2** inserted inside a cathode **1** to protrusions **3a**, **3a** on a pair of heater supports **3**, **3**, as shown in Figure 1.

Conventionally, welding of coil connectors **2a** and heater supports **3** has generally been carried out by a resistance spot-welding method involving fixing the positions of the heater **2** and heater supports **3**, **3** using a holding jig (not shown), and then sandwiching the coil connector **2a** and heater support **3** with a pair of welding electrodes **4**, **5** while applying a pressure of a few kilograms, followed by supplying electricity generated at a power source **6** to the welding electrodes **4**, **5** via feeder wires **7**, thus causing resistance heating and welding of the coil connectors **2a** and protrusions **3a**.

However, in the negative electrode structure, the heater coil **2** is formed from small heaters produced by winding extremely thin wires of high-melting metal such as tungsten with an extremely thin wire diameter of 20 to 50 μm at a coil outer diameter of 0.1 to 0.2 mm and a coil pitch of about 0.1 mm. In addition, the heater support **3** is formed from nickel plate or iron plate with a plate thickness of about 0.2 mm, giving rise to the problems described below.

Specifically, because the material of the welding electrodes **4** and **5** is a soft conductive metal such as chrome copper alloy, it is heated by the heat generated at the member to be welded during welding. For this reason, the contact surface of the welding electrodes **4** and **5** experiences oxide film adhesion or ablation, and the initial welding conditions are not preserved. Consequently, it is necessary to change parts or repolish the material of the welding electrodes **4** and **5** to its initial condition within an allowed level of every 100 to 200 spot welds. In addition, because the contact resistance of the member to be welded at the time of welding is extremely small, and it is necessary to apply a pressure of 3 kg or greater, there is the undesirable effect that the heater coil **2** deforms.

These types of problems can be reconciled by the use of laser welding methods. However, when laser welding is carried out using the coiled wire described above along with a base member to be welded such as iron, the two types of metal are generally welded by laser irradiation from the side of the wire. Although this method prevents deformation of the heater coil **2** due to aforementioned pressure, the wire is deformed during welding as a result of fusion of the high-melting wire and iron plate. In addition, there is the disadvantage that the weld strength is decreased due to abnormal processes such as sputtering or boring.

An object of the present invention is to offer a laser welding method for various types of metals, whereby deformation of the parts to be welded can be prevented while maintaining weld strength.

An example of embodiment of the present invention is described below in reference to Figure 2. Because the negative electrode structure is constituted using the same configuration as in Fig. 1, designations **1** through **3** are the same and descriptions will not be presented. After positioning the heater **2** and heater support **3** using a holding jig (not shown), the coiled connector **2a** is pressed against the heater support **3** by means of a press plate **10**, and the coiled connector **2a** is firmly affixed to the heater support **3**. Next, a focused beam **11a** from the laser device **11** is used to irradiate the heater support **3** from the side of the heater support **3**, thereby performing welding. An escape hole **10a** is formed in the vicinity of the welding spot in the press plate **10**, thereby preventing fusion.

Because irradiation of the beam is carried out from the side of the heater support **3** in this manner, the heater support **3** is melted due to irradiation of the beam in the direction indicated by the arrow **A** as shown in Fig. 3, and the material flows towards the side of the coiled connector **2a**. The nugget **3b** of the heater support **3** thus encloses the coiled connector **2a** without deforming it, and diffusion joining occurs, allowing joint strength to be maintained. Disconnection occurred outside of the joint during tensile testing, and thus it was determined that sufficient joint strength was preserved.

Fig. 4 shows another example of embodiment of the present invention. The connector of the heater support **13** in this example of embodiment was produced in the form of a sleeve. Thus, when the heater support **13** formed in this manner was used, a nugget **13a** of the heater support **13** was formed as a result of laser irradiation so that the entire circumference of the coiled connector **2a** was enclosed, as shown in Fig. 5. Consequently, the mechanical strength of the joint was additionally improved. In addition, in this example of embodiment, a configuration was produced in which the heater support **13** sandwiched the coiled connector **2a**, and thus the side **13c** opposite the side **13b** that was irradiated with the focused beam **10a** also functioned as a press plate **10**.

Although the above examples of embodiment described connection of the heater coil of an electron tube negative electrode structure, the method of the present invention can be widely used in applications outside of heater coils in electron tube negative electrode structures. In addition, the method can be similarly used when the connector **2a** is not a coil, but a straight wire. In addition, when joining the high-melting thin plate and base material to be welded, a small hole can be processed into the high-melting thin plate, and a phenomenon may be utilized in which the melt flow of base material to be welded covers over the aforementioned hole.

As is clear from the above description, by means of the present invention, welding can be carried out without deforming the part to be welded while preserving joint strength.

Brief Description of the Drawings

Fig. 1 is an oblique view of a conventional resistance welding method. Fig. 2 is a plan view of a example of embodiment of the laser welding method of the present invention. Fig. 3 is an enlarged cross section of the joint in Fig. 2. Fig. 4 is an oblique view showing another example of embodiment of the laser welding method of the present invention. Fig. 5 is an enlarged sectional view of the weld in Fig. 4.

2a	Coiled connector
3	Heater support
3b	Nugget
11	Laser device
11a	Focused beam
13	Heater support
13a	Nugget

Agent: Toshiyuki Usuda, Patent Attorney

Figure 1

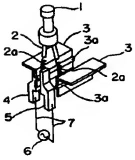

Figure 2

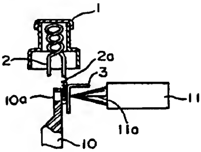

Figure 3

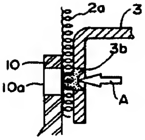

Figure 4

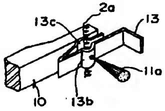

Figure 5